

## CM- 701 Elective –I

### (CM -701 (A) – Petroleum Processing Technology)

**Unit I** Origin and occurrence of petroleum crude, status of petroleum refining in India; composition of petroleum, classification and physical properties of petroleum.; evolution of crude oil and petroleum products, future refining trends.

**Unit II** Crude oil distillation process, pretreatment of crude, atmospheric and vacuum distillation process; secondary conversion processes; catalytic reforming, catalytic cracking and deep catalytic cracking.

**Unit III** Heavy residue up-gradation technologies; hydro-cracking, hydro-treating, vis-breaking and delayed coking alkylation, isomerisation, dehydrogenation processes, polymerization.

**Unit IV** Lubricating oil, grease and bitumen: de-waxing and de-oiling, de-asphalting, lube hydro-finishing, bitumen air blowing, sweetening and desulphurization; hydro-desulphurisation of petroleum products.

**Unit V** Refinery products, refinery gas utilization, LPG, propylene and hydrogen recovery, reformulated gasoline; present and future requirements.

#### References :

1. Nelson WL; Petroleum refinery engineering ; Mc. Graw hill
2. Hobson GD; Modern petroleum technology Part I & II; John Wiley & sons.

## **CM- 701 Elective –I**

### **(CM -701 (B) – Safety Engineering and Hazard Management)**

**Unit I** Origin of process hazards, Laws Codes, Standards, Case Histories, Properties of Chemical, Health, hazards of industrial substances.

**Unit II** Toxicology: Toxic materials and their properties, effect of dose and exposure time, relationship and predictive models for response, Threshold value and its definitions, material safety data sheets, industrial hygiene evaluation.

**Unit III** Fire & Explosion: Fire and explosion hazards, causes of fire and preventive methods. Flammability, characteristics of chemical, fire and explosion hazard, rating of process plant., Propagation of fire and effect of environmental factors, ventilation, dispersion, purifying, and sprinkling, safety and relief valves.

**Unit IV** Other Energy Hazards: Electrical hazards, noise hazards, radiation hazard in process operations, hazards communication to employees, plant management and maintenance to reduce energy hazards.

**Unit V** Risk Analysis: Component and plant reliability, event probability and failure, plant reliability, risk analysis, HAZOP and HAZON, event and consequence analysis (vapor cloud modeling) Designing for safety, measurement and calculation of risk analysis.

**Unit VI** Hazard Assessment: Failure distribution, failure data analysis, modeling for safety, safety training, emergency planning and disaster management, case studies.

#### **References:**

1. Crawl DA and Louvar J. A.; Chemical process safety fundamentals with applications- PHI
2. Wentz, Charles A; Safety, health and environmental protection - Tata McGraw Hill
3. Smith B.D.; Design of equilibrium state process ; Mc Graw Hill,
4. Van Winkle - Distillation - Mc Graw Hill, Book Co.

**CM- 701 Elective –I**  
**(CM -701 (C) – Pharmaceutical Technology)**

**Unit I** Practice of the following unit operation in pharmaceutical industries: Heat transfer, evaporation, distillation, drying, mixing, size reduction, crystallization, filtration, size separation, conveying, humidification, air conditioning and refrigeration.

**Unit II** Formulation, development of sterile dosage forms. Production facilities, environmental control and personnel in the production of sterile dosage form, compounding, processing, filtration, sealing, sterilization, packing and labeling of sterile dosage forms. Quality control tests like sterility, pyrogen, clarity, safety and leakage testing.

**Unit III** Types of tablets. Manufacturing of tablets by wet granulation, dry granulation and direct compression. Tablet processing problems and defects, tablet standardization: hardness, friability, weights variation, disintegration, dissolution and content uniformity tests.

**Unit IV** Capsules: Hard gelatin capsule, capsule size, formulation and preparation of filled hard gelatin capsules, soft gelatin capsule, soft gel - manufacturing procedures; quality control of capsules.

**Unit V** Cosmetics and Toiletries: Introduction, factors to be considered in the formulation of facial cosmetics, dentifrices, deodorant, antiperspirants, shampoos, hairdressing and hair removers.

**Unit VI** Pharmaceutical packing: packing components, types of packing containers and closures, materials used for and their pharmaceutical specification, method of evaluation, stability aspects of packaging materials.

**References :**

1. Leon lachman, Lieberman; Theory & practice of industrial pharmacy; Verghese P, Mumbai
2. Ganderto; Unit process in pharmacy.
3. HersheyD; Chemical engineering in medicine and biology - Plenum press, new york.
4. Chemical engineering in medicine - chern. Engg. Progrer syrnp series no. C 66, vol 62.

**CM- 702 Elective –II**  
**(CM -702 (A) – Transport Phenomenon)**

**Unit-I** Similarity in momentum, heat and mass-transport - Newton's laws of viscosity, Fouriers laws of conduction and Fick's laws of diffusion, Flux-transport property relationships, Estimation of transport properties measurement and correlations, velocity distribution in Laminar flow of falling film. Flow over an inclined plane, a circular tube an annulus and between two parallel plates.

**Unit-II** Shell balance approach for developing equations of change for momentum, heat and mass transport, Equations of change and their approximations for transport in one dimension.

**Unit-III** Transport equations in turbulent flow and equations for turbulent fluxes, velocity, temperature and concentration profiles for laminar and turbulent flow conditions, temperature and concentration profiles for conductive and convective transport in solids and fluids.

**Unit-IV** Macroscopic momentum and heat balance equations, Kinetic energy calculations. Constant area and variable area flow problems. Flow through bends, time determination for emptying of vessels.

**References:**

1. Bird R.B., Stewart W.E. and Lightfoot EW; Transport phenomena; Wiley tappon
2. Brodkey RS and Hershey -Transport phenomena a unified approach; TMH
3. Geancoplis; Transport processes & separation process principles; PHI learning.

**CM- 702 Elective –II**  
**(CM -702 (B) – Polymer Technology**

**Unit I**

**Polymerization Chemistry:** Chain, step and miscellaneous polymerization reactions and polymerization technique. Polymerization kinetics: Free radical, cationic and anionic polymerization, poly-condensation and polymerization.

**Unit-II**

**Polymerization Processes:** Bulk solution, emulsion and suspension polymerization, thermoplastic composites, fiber reinforcement fillers, surface treatment reinforced thermo-set composites resins, fillers, additives.

**Unit-III**

**Polymer reactions:** Hydrolysis, acidolysis, aminolysis, hydrogenation, addition and substitution reactions, reactions of various specific groups, cyclization and cross linking reactions, reactions leading to graft and block copolymer

**Unit IV**

**Manufacturing processes of important polymers:** Plastics- polyethylene, polypropylene polyvinyl chloride & copolymer, polystyrene; Phenol-formaldehyde, epoxides, urethane, Teflon, elastomers, rubbers, polymeric oils - silicon fibers - cellulosic (Rayon), polyamides (6:6 Nylon), Polyesters (Dacron). Acrylic-olefin.

**Unit -V**

**Composite materials:** Ceramic and other fiber reinforced plastics, Polymer degradation - Thermal, Mechanical, Ultrasonic, Photo, High energy radiation, Ecology and environmental aspects of polymer industries. Rheological Sciences Equations, Uni-coelastic models - Maxwell.

**References:**

1. Rodriguez; Principles of polymer systems; TMH
2. Billmeyer Jr, Fred W.; Textbook of polymer science; Wiley
3. David J Williams; Polymer science & engineering; PHI
4. Mc. Keley, JH; Polymer processing; John Wiley.

**CM- 702 Elective –II**  
**(CM -702 (C) – Novel Separation Techniques**

**Unit I** Limitations of common separation techniques- sedimentation, screening, filtration, evaporation, distillation, absorption, liquid - liquid and solid -liquid extraction.

**Unit II** Principles of membrane separation process classification, characterization and preparation of membrane, Analysis and modeling of membrane separation, Membrane modules and application.

**Unit III** Reverse Osmosis and ultra filtration, membrane characteristics and applications, Ion selective membranes and their application in electrolysis. Per vaporization and gas separation using membranes, Liquid membrane, Industrial applications.

**Unit IV** Foam and bubble separation, principle, classification, foam and surfactants, Separation techniques, Column Separations:

**Unit V** Zone melting and Zone refining, electrophoresis, desalting by freezing, centrifugation.

**Unit VI** Parametric pumping, thermal parametric pumping, batch, continuous and semicontinuous pumping, multi component separation, ph-parametric pumping, heatless parametric pumping,

**References:**

1. McCabe WI and Smith IC; Unit operation of chemical engineerin; TMH
2. King J.; Separation process; TMH
3. Kaup EC; Design factors in reverse osmosis - chemical engineering
4. Arden TV; Water purification by ion exchange; Butterworth, London.

CM- 703

## **Process Equipment Design-II**

**Unit I** Scale up criteria and scale up of process equipment. Process design calculations for heat exchangers equipment shell and tube heat exchangers general description, heat transfer coefficients and pressure drop by Kerns & Bells methods rating on existing unit.

**Unit II** Design of a new system having one or more units in series: single effect evaporation, multiple effect evaporator with boiling point elevation.

**Unit III** Process design calculations for mass exchange equipment plate and packed column for distribution and adsorption including column diameter and height.

**Unit IV** Detailed process and mechanical design, Flash drum, Kettle reboiler, condenser, cooling tower rotary drier.

### **References:**

1. Perry, Robert et al; Perry's Chemical Engg. Handbook; TMH
2. Ludwig E; Applied process design in chemical petrochemical plants; Gulf publishing co.
3. Mahajani V V, Umarji SB; Process Equipment Design; MacMillan Pub.
4. Kern D; Process Heat Transfer; TMH
5. Smith B. D; Design of equilibrium stages.
4. Coulson JM. Richardson JF; Chemical engg. Vol ;. Pergamon process

### **List of Experiments (Please expand it):**

Each student should design a complete chemical process plant with mechanical design details of at least three major equipments.

## Chemical Reaction Engineering –II

**Unit-I** Heterogeneous processes: Catalysis and adsorption; Classification of catalysts, Preparation of catalysts, Promoters and Inhibitors, General mechanism of catalytic reactions surface area and pore size distribution Rate equation of fluid solid catalytic reactions, Hougen - Watson & Poinule law models, Procurement and analysis of kinetic data, kinetics of catalyst deactivation.

**Unit-II** External transport processes and their effects on heterogeneous reactions yield and selectivity Reaction and diffusion in porous catalysts, Isothermal and non-isothermal effectiveness factors, Effect of intra-phase transport on yield, selectivity & poisoning, Global reaction rate.

**Unit -III** Design of catalytic reactors, Isothermal & adiabatic fixed bed reactor staged adiabatic reactors, Non isothermal, non-adiabatic fixed bed reactors, Fluidized bed reactors, Slurry reactors, Trickle bed reactors.

**Unit-IV** Models for fluid - solid non-catalytic reactions, controlling mechanisms, Diffusion through gas film controls. Diffusion through ash layer controls, Chemical reaction controls, fluidized bed reactors with and without elutriation.

**Unit-V** Gas-liquid reactions and liquid-liquid reaction, Rate equation based on film theory, Reaction design for instantaneous reactions and slow reactions, Aerobic Fermentation, Application to Design Tools for Fast Reactions.

### **References:**

1. Smiili J.M; Chemical engg. Kinetics; TMH
2. Denbig K.G & Turner KG; Chemical theory - an introduction to reactors; United press
3. Cooper G. & Jeffery JVJ; Chemical kinetics and reactor engg.; PHI
4. Rajaram J, Kuriacose JC; Kinetics and mech. of Chemical Transformations; MacMillan
5. Levenspiel O; Chemical reaction engg; Wiley Eastern Singapore.
6. Hougen, watson & Ragatz; Chemical process principles part 3
7. Fogler, HS; Elements of chemical reaction engg.; PHI

### **List of Experiments (Please expand it):**

Experiments based on above theory

CM- 705

## **Environmental Engineering**

**Unit-I** Environmental Management: Nature of environment, major component of life support system industrial development and environmental degradation, environmental impact assessment, national environmental policies, environmental guidelines for process industries, environmental pollution control through planned industrial development; environmental pollution and its effect on human beings, animal and vegetation system.

**Unit-II** Air Pollution: Sources and effect of air pollution, classification of air pollutants, emission standard of air pollution. Meteorological condition influencing air pollution, Chemical inversion, principle, working and design of control equipment for particulate emission and gaseous pollutants like cyclone separator, gravity settling chamber, multi-tray settling chamber, bag filter, scrubber, E.S.P.

**Unit-III** Water Pollution: Sources and effect of water pollution, water born diseases, classification of water pollutants, physical, chemical and bacteriological analysis of water; pollution laws and limits, effluent standards; design of waste water and industrial effluent treatment plants (physiochemical and biological), advanced treatment methods, modern trends in sedimentation and filtration.

**Unit-IV** Pollution due to Solid Waste and Noise: Nature of domestic, municipal, agricultural, industrial, Hospital, Nuclear Wastes; collection, treatment and disposal of solids waste; waste recovery system, solid waste management; noise pollution, sources, noise measurement and control; noise mitigation measures.

**Unit-V** Case study with respect to air, water and solid waste: Fertilizer industry, refinery and petrochemical industries, pulp and paper industries, training industry, sugar and alcohol industries, alkali industries, cement and steel industries.

### **References:**

1. Rao C S; Environmental Pollution Control Engineering; New Age India Ltd.
2. Mahajan S P; Pollution Control in Process Industries
3. Canter Lary; Environmental Impact Assessment; TMG
4. Keily; Environmental Engineering; TMG
5. Miller GT Jr; Environmental sciences-working with earth; Cengage Pub

### **List of Experiments(Please Expand it):**

1. To determine the BOD of a given water Sample.
2. To determine the D O of a given water Sample.
3. To determine the COD of a given water Sample.
4. To determine the ph value of a given water Sample.
5. To determine the Chlorides in a given water Sample.
6. To determine the Acidity in a given water Sample.

7. To determine the Alkalinity in a given water Sample.
8. To determine the Total Hardness in a given water Sample.
9. To determine the Turbidity of a given water Sample.
10. To determine the Aerobic Microbial colony count.
11. To determine the Total dissolve solid of a given sample.

### **CM- 706 – Minor Project**

Provision of Minor project is made as preparation phase-I for major project or to take it as an independent small project. For details of project see ME-805- Major project

## **CM- 707 – Industrial Training**

### **Objective of Industrial Training**

The objective of undertaking industrial training is to provide work experience so that student's engineering knowledge is enhanced and employment prospects are improved. The student should take this course as a window to the real World and should try to learn as much as possible from real life experiences by involving and interacting with industry staff. Industrial training also provides an opportunity to students to select an engineering problem and possibly an industry guide for their Major Project in final semester.

### **Scheme of Studies:**

Duration: Minimum 2 weeks in summer break after VI semester, assessment to be done in VII semester

### **Scheme of Examination:**

For the assessment of industrial training undertaken by the students, following components are considered with their weightage.

| <b>(a) Term Work in Industry</b>                                 | <b>Marks Allotted</b> |
|--|-----------------------|
| Attendance and General Discipline                                | 5                     |
| Daily diary Maintenance  | 5                     |
| Initiative and participative attitude during training            | 10                    |
| Assessment of training by Industrial Supervisor                  | 10                    |
| -----  |                       |
| Total  | 30*                   |
| -----  |                       |
| <b>(b) Practical/Oral Examination (Viva-Voce) in Institution</b> | <b>Marks Allotted</b> |
| 1. Training Report   | 15                    |
| 2. Seminar and cross questioning (defense)                       | 15                    |
| -----  |                       |
| Total  | 30                    |
| -----  |                       |

\* - Marks of various components in industry should be awarded by the I/c of training in Industry but in special circumstances if not awarded by the industry then faculty in charge /T.P.O. will give the marks.

During training students will prepare a first draft of training report in consultation with section in charge. After training they will prepare final draft with the help of T.P.O. /Faculty of the Institute. Then they will present a seminar on their training and they will face viva-voce on training in the Institute.

